Industry-of-Origin Prices and PPPs: A New Dataset for International Comparisons

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Background

- **Increased attention for PPPs** (theory, methodology and practical applications)
  - **Alternative GDP measures in international prices (ICP, PWT, Feenstra et al., 2004)**
  - **Output by industry**
- **Need for industry output PPPs (O-PPP) alongside expenditure PPPs (E-PPP)**
- **Previous attempts**
  - Jorgenson, Kuroda *et al*.
  - ICOP project at University of Groningen

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Aim of Paper

- **Provide SUT (Supply and Use Table) framework in which O-PPPs and E-PPPs can be consistently used:**
  - To measure real aggregate GDP in various ways
  - To measure industry output and value added in international prices
- **Provide new dataset of industry PPPs:**
  - 45 industries (aggregated from 221 3-digit NACE industries) covering total economy
  - Based on a motivated mix of O-PPPs and adjusted ('peeled') E-PPPs
  - 26 countries, including 19 EU member states
  - New benchmark year 1997

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Alternative measures of Real GDP

Expenditure approach: $$GDP = \sum_i \left(P_i^C C_i + P_i^E E_i - P_i^M M_i \right)$$

Production approach: $$GDP = \sum_j \left[\sum_i \left(P_{ij}^Y Y_{ij} - P_{ij}^X X_{ij} \right) \right] + T^Y + T^M$$

- Basic price of the product received by the producer
- Purchasers' price = basic price + taxes on the product - subsidies on the product + trade and transport margins in delivering the product to the purchaser

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Supply-Use Tables is Useful Framework to Reconcile Expenditure & Output PPPs (Table 1)

USE table at purchase prices

	Industries 1 …. j …. n	Total interme-diate use	Final domestic demand	Exports fob	Total use at purchase price
Commodities 1 : i : m	: …. $P_{Xij}X_{ij}$ …. :	: VX_i :	: $P_{Ci}C_i$:	: $P_{Ei}E_i$:	: $VX_i+VC_i+VE_i$:
Total at purchase price	…. VX_j ….	VX	VC	VE	VX+VC+VE
Operating surplus	…. $P_{Kj}K_j$ ….	VK			
Compensation	…. $P_{Lj}L_j$ ….	VL			
Taxes minus subsidies on production	…. T_{VAj} ….	T_{VA}			
Gross value added at basic price	…. GVA_j ….	GVA			
Gross output at basic prices	…. VY_j ….	VY			

SUPPLY table at basic prices

	Industries 1 …. j …. n	Total domestic supply	Import cif	Total supply at basic prices	Taxes minus subsidies	Trade and transport margins	Total su purchase
Commodities 1 : i : m	: …. $P_{Yij}Y_{ij}$ …. :	: VY_i :	: $P_{Mi}M_i$:	: $VS_i= VY_i + VM_i$:	: t_iVS_i :	: r_iVS_i :	: $(1+t_{Si}+r$:
Total at basic price	…. VY_j ….	VY	VM	VS= VY + VM	T_Y+T_M	R	VS+R+T
Taxes minus subsidies on products	…. T_{Yj} ….	T_Y	T_M	T_Y+T_M			

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Row identity reveals relationship between expenditure and output prices (see also Table 1)

$$\sum_j P_{ij}^X X_{ij} + P_i^C C_i + P_i^E E_i = \left(\sum_j P_{ij}^Y Y_{ij} + P_i^M M_i \right) + T_i^Y + T_i^M + R_i \; \forall i \quad (1)$$

With

X_{ij} = the quantity of product *i* used as intermediate input by industry *j*

p^X_{ij} = the purchasers' price paid by industry *j* for intermediate consumption of product *i*

C_i = quantity of product *i* for final domestic demand

p^C_i = the purchasers' price for final domestic demand of product *i*

E_i = quantity of product *i* exported

p^E_i = the purchase (f.o.b) price of exported product *i*

Y_{ij} = the quantity of product *i* produced by industry *j*

p^Y_{ij} = the basic price received by industry *j* for selling product *i*

M_i = the imported quantity of product *i*

p^M_i = the basic (c.i.f) price of imported product *i*

T^Y = total taxes net of subsidies on domestically produced products

T^M = total taxes net of subsidies on imports.

R = total trade and transport margins

Relationship between O-PPPs and adjusted E-PPPs (1)

- **Assumption 1**: basic price of a product *i* is equal in all its uses:

$$P_{ij}^{Y} = P_{i}^{Y} = P_{i}^{M} \qquad \forall i$$

- **Assumption 2**: trade, transport margins and taxes of product *i* do not depend on their uses:

$$P_{ij}^{X} = P_{i}^{C} = P_{i}^{E} \qquad \forall i$$

- **Result 1**: basic output price of supplied product *i* equals final expenditure price adjusted for net average taxes and margins:

$$P_{i}^{Y} = \frac{1}{(1 + t_{i}^{S} + r_{i}^{S})} P_{i}^{C} \qquad (6)$$

Relationship between O-PPPs and adjusted E-PPPs (2)

- **Result 2**: when relaxing assumption on equality of trade, transport margins and taxes of product *i* in all their uses:

$$P^Y = \frac{1}{(1+t^S+r^S)}P^C + \frac{1}{(1+t^S+r^S)}\sum_j \left(P_j^X - P^C\right)\frac{X_j}{Y} + \frac{1}{(1+t^S+r^S)}\left[\left(P^E - P^C\right)\frac{E}{Y} - \left((1+t^S+r^S)P^M - P^C\right)\frac{M}{Y}\right] \quad (7)$$

- **Implications of result 2**: adjustment of expenditure price to proxy output price depends on:
  - Size of differences between final expenditure prices and other purchasers' prices (on exports, imports and intermediate consumption
  - Ratio of exports, imports and intermediate consumption to total domestic output

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Relationship between O-PPPs and adjusted E-PPPs (3)

- **Assumption 3**: margins and next taxes on intermediate consumption and exports are lower than for final expenditure:

$$(t_i^X + r_i^X) < (t_i^C + r_i^C) \quad \forall i$$

$$(t_i^E + r_i^E) < (t_i^C + r_i^C) \quad \forall i$$

- **Result 3**: purchasers' prices for intermediate consumption and exports and basic price for imports after adjustment for margins and net taxes are all lower than final expenditure price:

$$P_{ij}^X < P_i^C \quad \forall i$$

$$P_i^E < P_i^C \quad \forall i$$

$$(1 + t_i^S + r_i^S) P_i^M < P_i^C \quad \forall i$$

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Adjusted Expenditure PPP useful for industry PPPs in limited number of cases

	No int. trade	*Only Export*	*Only Import*	*Both*
Only Final use	**(1) √**	**(4) overest**	**(7) underest**	**(10) ?**
Only Intermediate use	**(2) n.a.**	**(5) n.a.**	**(8) n.a.**	**(11) n.a.**
Both uses	**(3) overest**	**(6) overest**	**(9) ?**	**(12) ?**

- **Result 4: Under assumptions 1 and 3**
  - Only for final good, not internationally traded, the adjusted final expenditure price equals basic output price
  - When only used for intermediate consumption, no final expenditure price is available
  - In all other cases, the 'adjusted component' final expenditure price is biased

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Pro's and con's of output prices & adjusted expenditure prices for industry PPPs

- **O-PPPs:**
  - In theory preferable for industry PPPs
  - Often based on unit value ratios (product mix problems)
  - Often biased towards relatively homogeneous products
  - Problems with services output prices
- **Adjusted E-PPPs:**
  - Based on separate price survey with consistent methodology
  - When adjusted for margins and net taxes, still applicable to limited number of industries
  - Detailed information on margins and net taxes is often lacking (only with detailed SUT in prices and quantities)
  - Import and export adjustments are very problematic
- With application of SUT criteria better choices can be made, but remains largely empirical issue on industry by industry basis

Assessment of UVRs & adjusted expenditure PPPs for industry output comparisons

	Industry	ISIC rev. 3 code	Grade: ICP Expenditure PPP	Grade: ICOP Production PPP
1	Agriculture	01-05	0	5
2	Mining and quarrying	10-14	0	4
3	Manufacturing	15-37	2	4
4	*Food, drink & tobacco*	15,16	3	4
5	*Basic goods*	17,20,21,23-28	1	4
6	*Non-durable*	18,19,22,36,37	2	4
7	*Durable*	29-35	2	2
8	Electricity, gas and water supply	40,41	3	4
9	Construction	45	4	1
10	Trade	50-52	0	2
11	Hotels & catering	55	4	0
12	Transport	60-63	1	3
13	Communications	64	3	3
14	Finance	65-67	0	1
15	Real estate activities	70	4	1
16	Business services	71-74	1	0
17	Public administration and defence	75	0	0
18	Education and health	80,85	0	0
19	Other services	90-95	2	0

Note: ranking indicates 0 (not useful), 1 (very poor), 2 (poor), 3 (acceptable), 4 (useful) and 5 (very useful).

Source: assessment based on E-PPPs for OECD from 1999 round and O-PPPs for 1997 from Groningen Growth and Development Centre.

A New ICOP Dataset for Industry-of-Origin PPPs

- **Improvements over previous ICOP studies:**
  - uses consistent criteria for the selection of the PPP method (O-PPPs or adjusted E-PPPs)
  - uses a single set of industry weights (221 industries)
  - applies multilateral (EKS) weighting system for all industries;
  - country and industry coverage is much bigger
- **Consistent approach:**
  - Above industry ("basic heading") level use of EKS multilateral weighting system
  - Weights are based on gross output or "matched output" depending on quality of prices (output coverage, variation, number of products covered)
  - Below industry ("basic heading") level use of best possible source on broad sector basis (agriculture, mining, manufacturing, public utilities, distribution, transport & communication and other services)

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Conclusions and Next Steps

- Consistent deflation of SUT in international prices possible for a large set of countries
  - Alternative measures of real GDP
  - Measure of real industry output
- Issues to be resolved:
  - Derivation of intermediate input PPPs
  - Deflation of margins
  - Deflation of taxes and subsidies
- Possible applications:
  - EU KLEMS growth accounting and productivity
  - Price convergence
  - IO-studies and decompositions
- Extension
  - with factor input PPPs (capital, labour)
  - Extension to non-OECD countries

Agricultural PPPs are based on off-farm prices from FAO database

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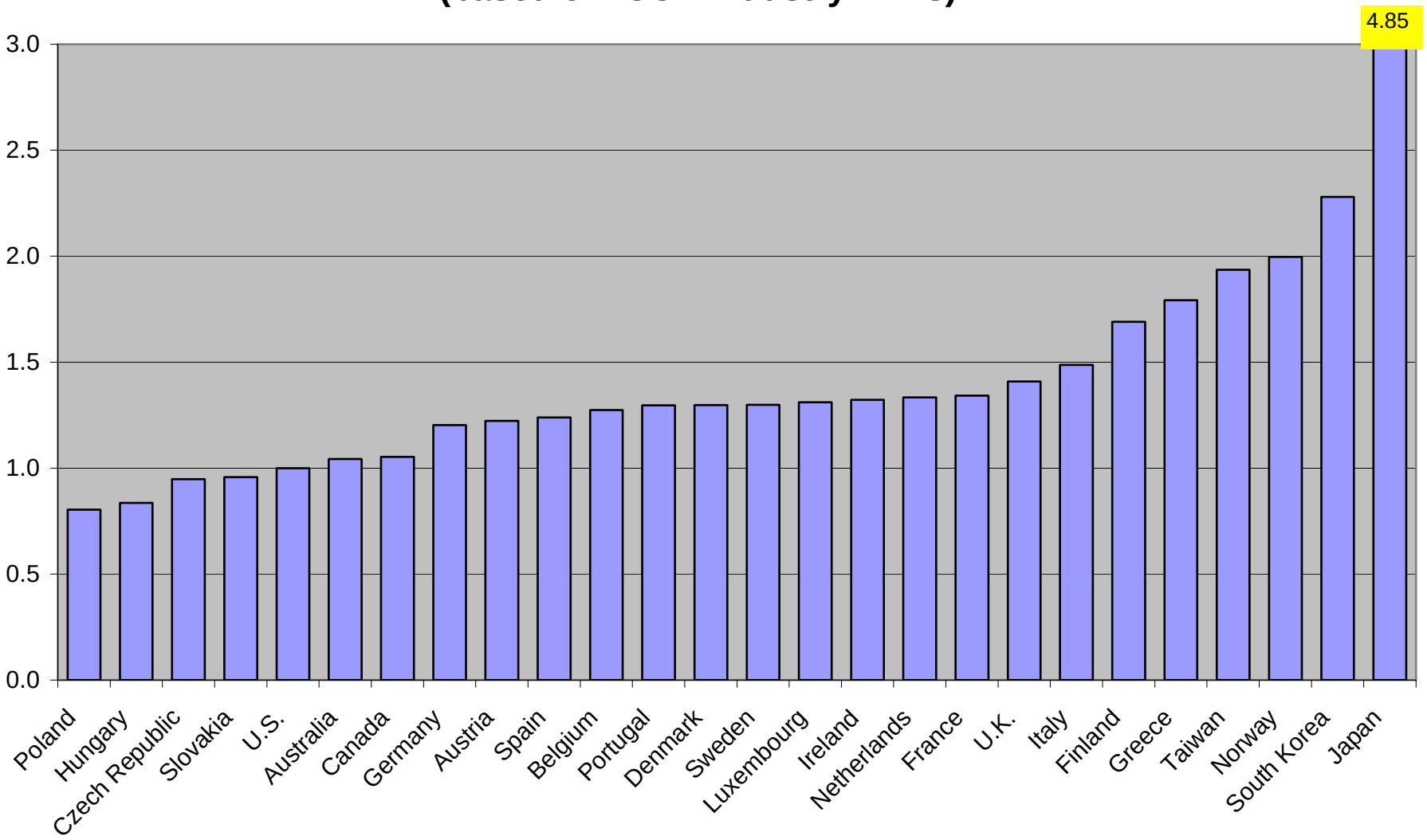
	Agriculture, forestry and fishing	Number of product PPPs	%-coverage of output with PPPs	Industry output in 1997 mln FFR	EKS PPP (FF/US$)* output weighted	Relative price level (PPP/exch. rate)
011	Growing of crops	59	72%	220,581	9.06	1.55
012	Farming of animals	11	77%	147,416	6.65	1.14
013	Mixed farming	0	0%	56,269	*7.83*	*1.34*
014	Agricultural services	0	0%	16,201	*7.83*	*1.34*
015	Hunting	0	0%	360	*7.83*	*1.34*
020	Forestry	0	0%	23,203	*7.83*	*1.34*
050	Fishing	0	0%	12,076	*7.83*	*1.34*
01-05	**Agriculture, forestry and fishing**	**70**	**67%**	**476,107**	**7.83**	**1.34**

* PPPs within individual industries are Fisher PPPs with U.S. as base

With exception of East European Countries, U.S. has lowest prices in agriculture

Relative Prices of Agriculture, Forestry and Fishing, US=1.0
(based on ICOP industry PPPs)



Manufacturing PPPs for EU countries are now based on common database for manufacturing products (PRODCOM), matched through Germany with US

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	Manufacturing	O-PPP/ E-PPP	Number of product PPPs	%-coverage of output with PPPs	Coeffi-cient of variance	Industry output in 1997 mln FFR	EKS PPP (FF/US$)* via Germany	Relative price level (PPP/ exch. rate)
15-16	**Food, drink & tobacco**		**183**	**65%**		**724,577**	**7.00**	**1.21**
	Food, drink & tobacco (EKS PPP)						**7.04***	
151	Production, processing and preserving of meat	O-PPP	41	79%	0.03	172,952	7.54	1.29
152	Processing and preserving of fish and fish products	O-PPP	15	99%	0.02	11,417	6.35	1.09
153	Processing and preserving of fruit and vegetables	O-PPP	25	61%	0.09	31,141	7.91	1.36
154	Manufacture of vegetable and animal oils and fats	E-PPP	0	55%	0.05	15,441	7.08	1.21
155	Manufacture of dairy products	O-PPP	20	84%	0.04	125,456	7.87	1.35
156	Mnf. of grain mill products, starches & starch products	O-PPP	15	72%	0.03	28,141	7.84	1.34
157	Manufacture of prepared animal feeds	O-PPP	2	22%	0.36	48,697	5.09	0.87
158	Manufacture of other food products	O-PPP	53	48%	0.03	192,025	6.72	1.15
159	Manufacture of beverages	O-PPP	12	73%	0.05	93,947	7.35	1.26
160	Manufacture of tobacco products	na	0	0%	0.00	5,359	*7.00*	*1.21*

Manufacturing PPPs show considerable larger output and product coverage than before

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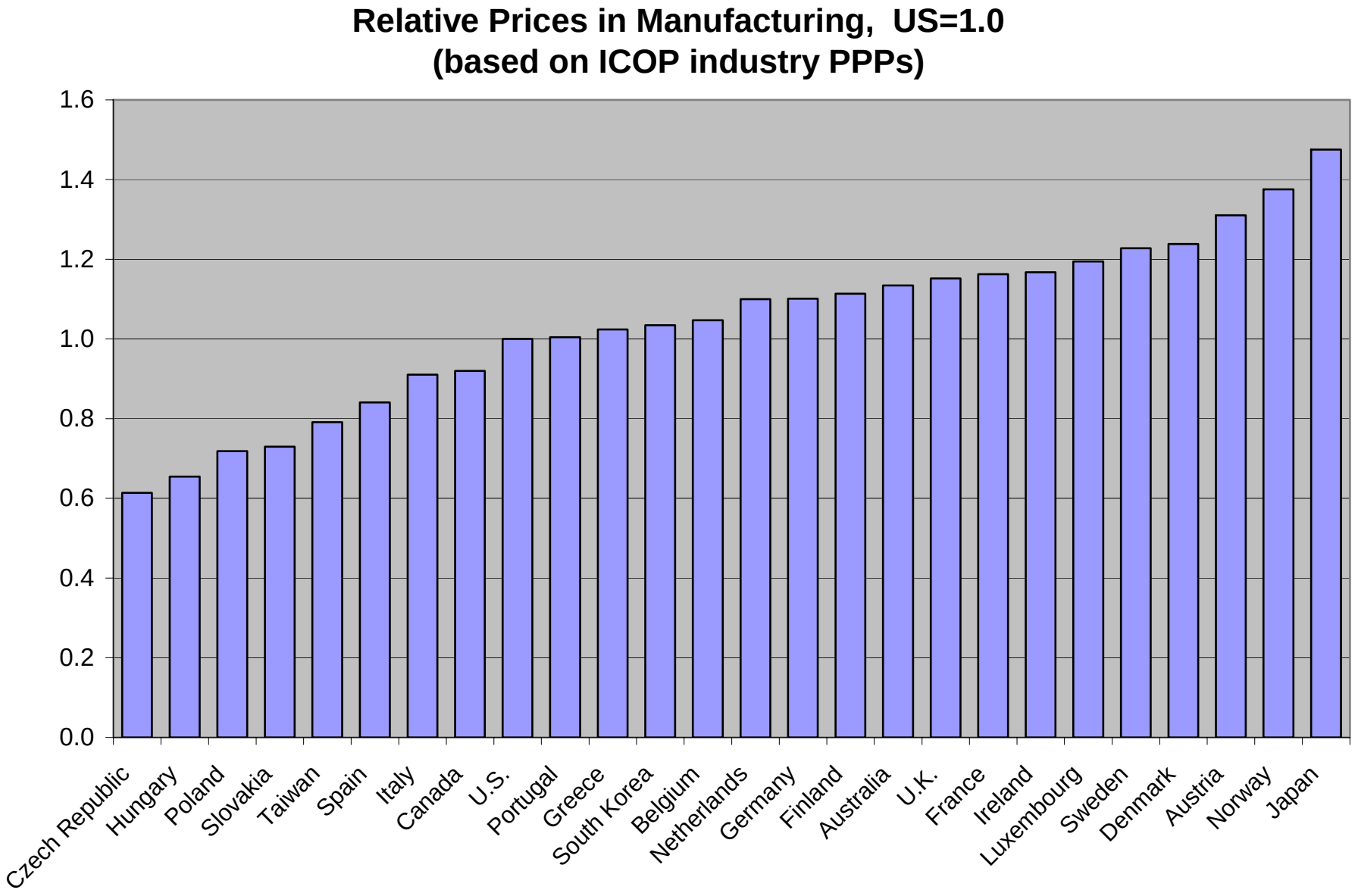
	Manufacturing	Number of product PPPs	%-coverage of output with PPPs	of which coverage with adjusted E-PPPs	Industry output in 1997 mln FFR	Fisher PPP (FF/US$)* via Germany	EKS PPP (FF/US$)* via Germany	Relative price level (PPP/ exch. rate)
15-16	Food, drink & tobacco	183	65%	1%	724,577	7.00	7.04	1.21
17	Textiles	33	17%	9%	106,121	7.57	7.27	1.25
18	Clothing	17	9%	0%	79,633	16.00	15.54	2.66
19	Leather and footwear	19	48%	0%	25,884	6.27	6.06	1.04
20	Wood & products of wood and cork	36	51%	0%	61,640	6.05	6.22	1.07
21	Pulp, paper & paper products	34	33%	0%	114,405	6.22	6.39	1.10
22	Printing & publishing	11	39%	0%	202,612	8.34	8.92	1.53
23	Mineral oil refining, coke & nuclear fuel	0	41%	41%	188,489	3.00	3.18	0.54
24	Chemicals	101	32%	13%	486,779	6.55	5.82	1.00
25	Rubber & plastics	42	48%	0%	163,137	4.45	4.45	0.76
26	Non-metallic mineral products	55	42%	0%	124,465	5.25	5.30	0.91
27	Basic metals	42	23%	0%	208,509	5.93	6.22	1.07
28	Fabricated metal products	38	8%	1%	294,807	6.23	6.60	1.13
29	Mechanical engineering	58	14%	7%	297,968	5.96	6.01	1.03
30	Office machinery	0	17%	17%	58,452	5.12	5.12	0.88
31	Electrical machinery and apparatus	1	7%	7%	150,798	7.19	7.70	1.32
32	Radio, television and communication eq.	1	17%	17%	142,113	8.21	7.54	1.29
33	Medical, optical and precision instruments	11	19%	19%	117,502	8.43	8.37	1.43
34	Motor vehicles	3	63%	32%	456,316	10.25	9.83	1.68
35	Other transport equipment	0	14%	14%	201,169	6.21	6.34	1.09
36-37	Miscellaneous manufacturing	11	17%	12%	106,573	7.89	7.51	1.29
15-37	**Total manufacturing**	**696**	**36%**	**10%**	**4,311,950**	**6.81**	**6.78**	**1.16**

Relative price spread in manufacturing is more than 2:1



Derivation of PPPs in Retail Trade is now consistent with commonly applied approach in national accounts

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	Retail Sector	Number of product PPPs	Sales E-PPP	Margin in % of sales value	Purchase PPP derived from margins	Margin Fisher PPP (FF/US$)	Sales in 1997 mln FFR	Relative price level (PPP/ exch. rate)
52	**Retail trade**	**219**		**28%**		**6.00**	**1,732,709**	**1.02**
	Retail trade (EKS PPP)					**5.98***		
521	Non-specialized retail trade in stores	87	5.83	18%	6.42	4.70	874,026	0.80
522	Retail sale of food, beverages and tobacco in specialized stores	34	5.77	38%	4.93	7.61	77,192	1.30
523	Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles	5	5.47	32%	5.09	5.43	161,618	0.93
524	Other retail sales of new goods in specialized stores	50	5.92	39%	5.68	7.11	514,735	1.22
525	Retail sale of second-hand goods in stores	2	4.60	50%	4.02	5.35	11,235	0.92
526	Retail sale not in stores	35	6.00	47%	5.61	7.30	84,778	1.25
527	Repair of personal and household goods	6	4.94	70%	4.08	5.52	9,124	0.95

* EKS PPP

With exception of Eastern Europe and Japan, relative price spread in services is not larger than in manufacturing

Relative Prices in Market Services, US=1.0
(based on ICOP industry PPPs)